Stat 436/536 (An Introduction to) Time Series Analysis Fall 2010

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Prerequisites: Stat 436: Stat 410 Stat 536: Stat 410 and consent of instructor
Recommended: Some background in Matrix algebra and basics of expectations and covariances

Course Description: An introduction to time series analysis using time domain methods (time series regression, autoregressive, moving average, and ARIMA models) and explores estimation, model building and forecasting. Additionally, frequency domain methods (spectral analysis) will be briefly introduced. The goal of the course is to acquire the skills required to investigate data collected as a univariate time series.

Required Texts:
Cowpertwait and Metcalfe (2009): Introductory time series with R [electronic resource]
http://isbn.lib.montana.edu/uhtbin/cgisirsi/9vfEhUQttB/BOZEMAN/145660100/88

Cryer and Chan (2008): Time series analysis [electronic resource]: with applications in R
http://isbn.lib.montana.edu/uhtbin/cgisirsi/g48VTUjb9J/BOZEMAN/145660100/8/1724073/Cryer,+Jonathan+D

Schedule: TTh 11-12:15 in Reid 202 except holidays

Office Hours: M 2:10-3, T 10-11, Th 10-11 and by appointment

Course Evaluation:
There will be approximately bi-weekly homeworks, one project, two exams, and a self-graded component

Midterm Exam	20%
Final Project	20%
Final Exam	25%
Homework	30%
Self-Graded Component	5%

Cut-offs for grade assignment:

A 93%	C+ 77%	F <60%
A- 90%	C 73%	
B+ 87%	C- 70%	
B 83%	D+ 67%	
B- 80%	D 60%	

HW: We will have around 5 or 6 homework assignments that will be equally weighted to find your overall score on Homework. Late HW will be 10% off the total possible per day late (including weekends) and will only be accepted until the assignment is graded. Once grading is completed, no further homework will be accepted unless prior arrangements are made. Email submissions are ok, especially for late HW.

Exams: The first exam will take place outside of the regular class time around the middle of the semester, with the date announced at least two weeks prior. There will be some flexibility available for the exam time on the announced day, but assume that it will take place in the early evening. The final exam may be a take home or a mixture between a take home and in class exam and will likely be given the week before finals week.

Project: You will have one data analysis/ methods project that you will complete near the end of the semester. More details will be provided in class after the first exam, but you can expect to do some writing and interpretation of results and/or explore methods not covered in the course. You will do some preliminary work on the project as parts of the homework assignments. If you have a data set from your own research this will be a great opportunity to begin analyzing it and exploring methods of specific interest for your project

Self-Graded Component: You will also evaluate your own performance (preparation for class, participation in discussions, etc.) in the course. I reserve the right to modify this component of your grade but have yet to need to do that in any courses that I have used this grading component.

Attendance: I expect you to be in class or let me know why you are not there.

Academic Dishonesty: It is expected that students will abide by university regulations regarding academic dishonesty. Instructions will be given on each type of activity regarding the use of outside resources and working together.

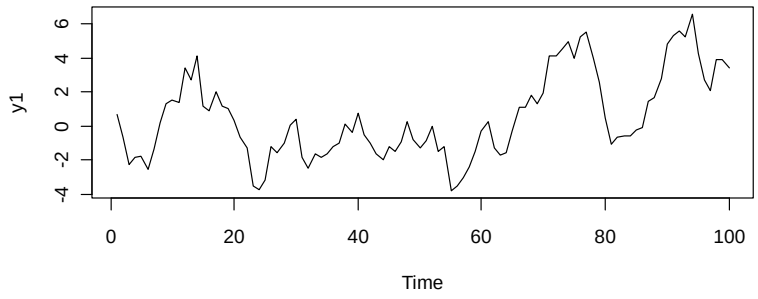
Group Work: You may work in small groups on some or all of the homework unless otherwise instructed. Please note the individual(s) that you have worked with if you are working together and make sure you understand everything that is turned in. Exams and quizzes will not be group work.

Computer package: We will exclusively use R for the homework and projects. You will need to learn basic R skills if you do not have them. The "Introduction to R" online or in the back of Cryer and Chan are nice starting points. I will try to provide all required R code to get you started but you may need to figure some things out for yourself to complete the assignments. Make sure you are working from a relatively up to date version of R (2.10.1 or greater should work).

Difference between Stat 436 and 536: The lectures will be exactly the same, but the expectations on the homeworks, exams, and projects may differ depending on your level of enrollment. On each HW and the exams there may be an additional set of questions that may be more theoretical or difficult to complete. On the final project, the students registered for 536 will be expected to explore a topic not covered in the course related to time series methods and demonstrate its use. Students in 436 can use the tools discussed in the course to analyze a time series. Thus the grading rubrics will differ considerably between the two simultaneous versions of the course, often in terms of total points possible on each component or the expectations for the level of the work.

Outline of Topics:

Cryer/Chan Chapter	Topic	Cowpertwaite/Metcalf Chapter
CC Ch 1	What is Time Series Analysis? (and some basic R tips and plotting information)	CM Ch 1
CC Ch 2	Time Series and expectation, variance and covariance	CM Ch 2
CC Ch 3	Time Series Regression for time series trends/ Mixed models for TS regression (ARMA errors)	CM Ch 5
Supplement on nonparametric regression for time series (Additive Mixed Models)		
CC Ch 4	ARMA models/ Stationary Models	CM Ch 4,6
CC Ch 5	ARIMA models	CM Ch 7
CC Ch 6	ACF and PACF for model diagnostics	CM Ch 2
CC Ch 7	Parameter Estimation	
CC Ch 8	Diagnostics	
CC Ch 9	Forecasting using ARIMA models	
CC Ch 10	Seasonal ARIMA models	
CC Ch 11	Time Series Regression (Intervention/ Outlier) models	
Dynamic linear models/ State space models		CM Ch 12
CC Ch 13	Spectral Analysis	CM Ch 9
CC Ch 14	Estimating the Spectrum	CM Ch 9 (10?)
Additional (Supplemental) Topics (if time allows and depending on student interest):		
	Wavelets and dynamic Fourier Analysis	
	Multivariate Time Series (Spectral and/or VAR)	
	Generalized linear ARMA models	
CC Ch 12	ARCH and GARCH models	CM Ch 7
	Long Memory Processes (Fractional differencing)	CM Ch 8
CC Ch 15	Threshold Models	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-2
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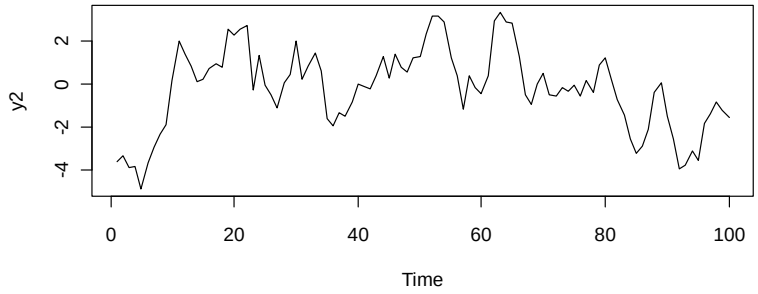
2
4
6
0
20
40
60
80
100
Time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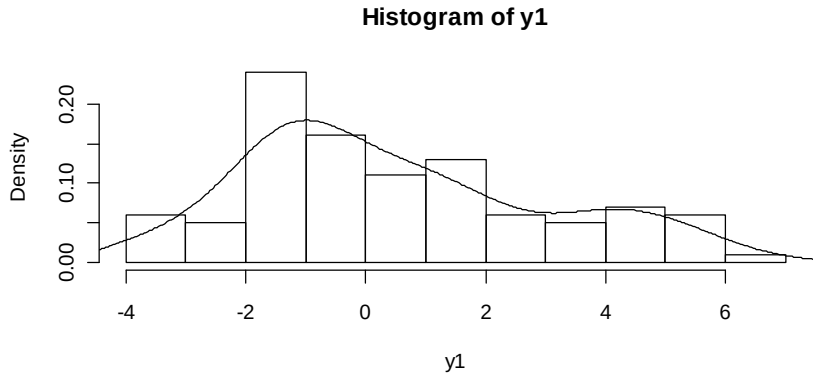
2
0
20
40
60
80
100
Time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0.20
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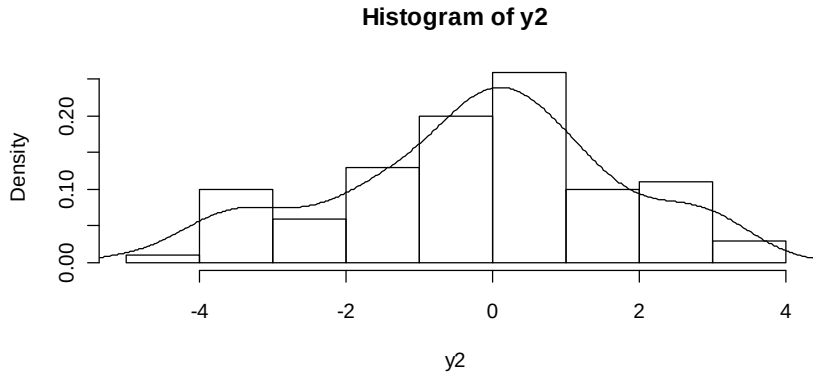
-2
0
2
4
6
y1


Histogram of y2
Density
0.00
0.10
0.20
-4
-2
0
2
4
y2